68. The apparatus of claim 66 wherein said optical connection of said at least two illumination areas and said at least one source of illumination comprises fiber optics.

69. The apparatus of claim 67 wherein said optical connection of said at least two illumination areas and said at least one source of illumination comprises fiber optics.

REMARKS CONCERNING THE AMENDMENTS

The above cancellation of claims and the addition of new claims was done in an effort to better define the invention and to respond to issues raised in the prosecution of the parent application, U.S. Serial No. 08/385,073.

Antecedent basis for the new claims may be found generally in the specification and for example as follows:

For claims 56-63 and 64-69, see original claim 1; page 4, lines 19-28; page 5, lines 13-18; page 6, lines 2-10; page 8, lines 21-32; and page 8, line 35 through page 9, line 4). Although the terms "optical connection" and "circular" do not appear to be recited literally in the specification, the concept of those terms is clearly presented to one of ordinary skill in the art, which is the requirement of 35 U.S.C. 112, first and second paragraph. See Ex parte Janin, PTO Bd. Of App., 1979, 209 U.S.P.Q. 763 and In re Anderson, C.C.P.A. 1973, 176 U.S.P.Q. 331 which expressly decide that:

> "While the specific statement has not been set forth as such,...the question is not whether the word or phrase was specifically used in the specification as filed, but whether there is support for the term employed." Ex parte Janin, *supra*; and
>
> "...is the **concept** of [the term in issue] present in the original disclosure?" (Emphasis added) In re Anderson, *supra*.

The concept of these terms is clearly present in the specification. With respect to the

word circular, the original disclosure specifically recites "cylindrical," "conical," and "Conical annular spaces or rings." Additionally, the phrasing on page 8, line 35 through page 9, line 4 approaches the strict geometric definition of a circle, the locus of all points in a plane which are equally spaced from a single point. This wording reflects that all illumination sources within an aperture (i.e., like signal sources as opposed to different signal sources) "...provide substantially constant values of spacing between all points within a given source aperture and those [points] within a given detection aperture..." The concept of a circular distribution is clearly present in the original disclosure.

Likewise the concept of optical connection between the illumination areas and the illumination source, and the detection aperture are disclosed in the original disclosure. For example, the discussion of a pathway for illumination or transmission of light in pathways requires an optical connection to have the illumination or light travel from one position to another. This travel requires an optical connection.

ISSUES OF PATENTABILITY FOR NEW CLAIMS 56-68

The combinations of prior art asserted against the claims in the parent application (08/385,073) are not supportive of obviousness under 35 U.S.C. 103 against the new claims. There are clear and definitive structural differences which are not taught by the prior art of record and which provide technical improvement to the performance of the claimed process and apparatus of claims 56-69.

Applicant and the Examiner appear to believe that the best reference used in the final rejection in the parent application for a showing of a circular distribution of optical fibers used for detection which surround an illumination source of optical fibers is the Borsboom U.S. Patent No. 4,884,891, especially Figure 4 (hereinafter, "Borsboom"). However, there is a clear structural aspect to that showing which is excluded by new claims 56-63 and which provides clear

unobvious and improved results.

Borsboom teaches the use of both illumination and detection fibers in the central area of the apparatus (e.g., Figure 4, segment **2**, with detection and illumination fibers **3** and **4**). The present claim 56 specifically recites a plurality of

> "different paths of illumination each comprising a distribution of illumination means surrounding and equally spaced from a central detection aperture."

This language specifically excludes the structure of Borsboom in which there is only one illumination area. The present claim 57, and all claims dependent thereon also specifically recite a central detection aperture "consisting of an optical connection to a detector system." This language again specifically excludes the structure of Borsboom where optical connections to both illumination and detection means are present within the central area.

These structural differences provides significant performance benefits in the present invention. A first benefit relates to the relative signal-to-noise ratio obtainable with the present invention compared to that obtainable by Borsboom. The optical signal received by the detection means is proportional to the product of the effective solid angle of illumination transferred to the sample, the effective area of the illumination, the effective solid angle of the energy collection from the sample, and the effective area of the energy collection from the sample. Borsboom shares the area of the central aperture between illumination and detection fibers. Therefore both the illumination and central detection areas must be smaller than the equivalent areas in the present invention where in claims 57-64 and 66-69 the central area consists of detection fibers. Another consideration is the fact that the fundamental noise of optical detectors is proportional to the square root of the detector area, which in turn is related to the area of energy collection from the sample. The signal-to-noise ratio is therefore proportional to the product of the illumination area and the square root of the detection area, and it is advantageous to utilize the larger aperture for illumination and the smaller aperture for detection. From a practical standpoint, sources such

as tungsten halogen projection lamps and reflectors can efficiently fill the large effective area and solid angle available with the surrounding apertures while many detection means, such as the diode-array spectrophotometer mentioned in the present specification, have more limited optical throughput and are not able to match the throughput provided by the surrounding apertures, thereby reducing the signal-to-noise ratio otherwise obtainable by using the structure of the present invention.

Assuming that Borsboom creates and receives two different signals, one signal is received by detection fibers **3** (which are randomly distributed within the central area according to claim 4) and the other signal is received by detection fibers **7** at the periphery of the apparatus. Because the central fiber **2** of Borsboom contains both illumination and detection fibers which are randomly distributed, there would be a fairly broadly distributed signal detected by detector fibers **3** since the signal would be received in a random distribution of detector fibers from a random distribution of illumination fibers. The signals detected by the optical fibers **3** would therefore define a summation of signals from a number of differences (between the randomly distributed detector and illumination fibers within the central fiber **2**). The strongest signal to a detector fiber **3** would effectively have little distance component at all, coming from adjacent illumination fibers **4**. Signals (illumination) from other illumination fibers randomly distributed in the central fiber would create a variety of different path lengths from the randomly distributed illumination fibers. The range of distances within the central fiber area **2** relative to the mean distance is much greater than the range of distances relative to the mean distance between the central fiber area **2** and the outer ring of detector fibers **7**. Therefore, the comparison of illumination (or the signals created therefrom) to the central fiber **2** detection fibers **3** and the outer distribution of detection fibers **7** could well be a nearly valueless comparison. The comparison would not allow for the removal of a clear distance-related component to the detected illumination. This inability is because the distance varies by significant multiples of fiber diameters within the random distribution, from less than a single fiber diameter distance to multiple fiber diameter distances.

The presently recited process and apparatus specifically avoids the problem created by the configuration of Borsboom by having the central area provide only detection and outer rings providing illumination. Because there are multiple illuminating points within each of the outer rings, and because the outer rings surround the detection area, there is an extremely high consistency to the distance between all illumination points in each ring and centrally located detection area. The detection area lies over the center of the circular distribution of illuminators, and there is a very good illumination density at the site of the detection. Therefore the configuration recited in claims 56 and 60 (the newly submitted independent claims) provides a clear technical advantage over the configuration shown by Borsboom. The structural limitations of this different configuration which provide the advantages is specifically recited in the claims and therefore provides unobvious limitations to the newly submitted claims. As all the new claims depend from claims 56 and 60, all of the newly submitted claims are unobvious over Borsboom, alone, or in combination with prior art disclosed in the original specification and/or Howarth and Hirao.

The secondary references of Hirao and Howarth clearly fail to overcome the deficiencies of the Borsboom reference on this significant and unobvious structural improvement recited in claims 56 and 60. Hirao merely shows two distinct point sources of illumination with a single detection point. This provides a single set of reference points, with high variability potential by relative movement of either of the pair of illumination sources. The configuration of Hirao also provides little illumination for the detector, with only a single emitter for each signal. Nothing in Hirao would motivate one ordinarily skilled in the art to alter the configuration of Borsboom to the structure of the claimed invention, <u>with any prospective expectation of the benefits found by Applicant</u>. Without that prospective benefit, a rejection on the grounds of obviousness can not be supported by the references.

Howarth likewise fails to provide any teaching which would motivate one skilled in the

relevant art to modify the configuration of Borsboom towards the structure and process recited in the claims. Howarth shows a set of two detectors and one illuminator source. That teaching would not support a rejection of the presently claimed invention of claims 56 and 60 for obviousness in combination with Borsboom, Hirao, and the teachings of prior art in the specification.

The configuration of the present invention, in having a central detection area, without illumination present in that area, and with an equidistant distribution of illumination means around the central detection area provides an additional difference in performance capability which is not available from the prior art and which is not taught to be obvious by the prior art used in the last rejections of record in the parent application. An additional consideration relates to the nature of the interactance measurement provided by the present invention. The measurement consists of determining the absorption of energy by the sample material for each of a plurality of different path lengths and relating these determinations to each other to reduce errors in measuring the interactance of the desired portion of the sample and, subsequently, calculating the desired quantitative or qualitative information. There is an optimum optical pathlength for determining absorption within the sample. At a zero pathlength, which is approximately what Borsboom effects within the central fiber **2**, all the energy is transmitted from the illumination means to the detection means and there is no usable signal information because there is no absorption. If the pathlength is too great, the loss of energy due to absorption and scattering is excessive and the usable signal is reduced. There is a relatively broad optimum spacing between the illumination and detection apertures. The structure taught by Borsboom, however, results in very small and uncontrolled pathlengths between the randomly placed illumination and detection fibers within the central aperture and admittedly provides that the "...back-scattered light collected by the illuminating fibre will...be hardly, if at all, absorbed..." (Column 2, lines 34-46). Therefore the energy detected through the central aperture will provide little or no usable signal representing the interactance within the sample for this path. The controlled separation between each of the

illumination areas and the detection area taught by the present invention allows the pathlengths to be chosen for optimum performance.

Using the illuminators in an outside (surrounding) configuration has two benefits. A first benefit is a higher illumination level, since each illuminating portion of the array of sources will contribute a component of illumination that will be received in the central detection area, as opposed to a single point-to-point transmission with a point illuminator and point detector. The second benefit is that the greater distance from the outside illumination distribution to the central detector provides better blocking of background light to the detector. The lower amount of light received from the illumination source would allow this background light (noise) to be proportionately smaller with respect to the meaningful data (signal) received from the illumination sources.

The newly submitted claims are clearly patentable over the combination of references used in the rejection of claims in the parent application.

The Applicant respectfully requests that the preliminary amendment described herein and the associated arguments be entered into the record prior to examination and consideration of the above-identified application.

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